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CAN WE INDUCE PROMPT REGENERATION IN SELECTIVELY-CUT PONDEROSA PINE STANDS?

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Natural reproduction of ponderosa pine in cut-over stands in western Montana is slow and uncertain. Usually new stands take thirty years or longer to become fully stocked, and often the presence of advance Douglas-fir growth precludes the establishment of pine reproduction. Successful forest management requires prompt establishment of desirable reproduction following harvest cutting to prevent future gaps in volume production. Prompt restocking requires a thorough understanding of the complex factors which affect establishment of reproduction. It also calls for effective manipulation of those factors which can be controlled.

Extensive areas of seedbed have been prepared by soil scarification and prescribed slash burning on the Kootenai National Forest in the past few years. Heavy ponderosa pine seed fall on these areas in the autumn of 1948 2/ provided an opportunity to study the causes of variation in stocking of first-year seedlings. Effects of seedbed condition and seed tree stocking were observed and are reported upon. The study shows that ample seed available for germination and suitable seedbed are important requirements for adequate reproduction. A concurrent study 2/, on part of the same areas, demonstrated that rodents were an important factor in reducing the effectiveness of the 1948 seed crop.

1/ The authors wish to acknowledge the work and valuable cooperation of Howard E. Ahlskog, Earl M. Welton, and Ernest J. Grambo, Kootenai National Forest, which made this study possible.

2/ Dispersal and Survival of Seed in a Partially-Cut Ponderosa Pine Stand by A. E. Squillace and Lowell Adams. Northern Rocky Mountain Forest and Range Experiment Station, Research Note No. 79. March, 1950.

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Method of study

Eleven different locations in cut-over stands in the vicinity of Warland, Montana, were studied. These study areas are in the following drainages:

Warland Creek - 1 location
Bristow Creek - 4 locations
Bluesky Creek - 5 locations
Jackson Creek - 1 location

Reproduction data were collected on 941 milacre plots, and seed trees were measured on 41 quarter-acre plots. Most of the stands had been cut selectively from one to two years prior to the heavy seed fall in the autumn of 1948. Stands in Bristow Creek, however, were cut after the peak seed fall; thus, seed from the entire original stand was available for germination. In contrast, seed on the other locations was produced by the residual trees only. Including the Bristow Creek areas, therefore, made possible the consideration of larger amounts of seed trees per acre in the analysis (up to 160 sq. ft. of basal area per acre) than would be possible within the range of most cut-over stands. Further, it provided a lead to future work with seedbed preparation in advance of logging.

One of the locations in Bristow Creek, known as landing C-1, was studied in detail and has been analyzed separately as well as in combination with the other locations. All data were analyzed by simple correlations.

Approximate conversions from basal area stocking to numbers of trees and board foot volume are given in Appendix, table 1, at the back of this report. This table is presented for the information of readers who are not conversant with measurement of timber stands in basal area.

Effect of the seedbed condition

Mineral soil provided a significantly better surface for germination than natural duff. The relative effectiveness of these two conditions is shown in Figure 1. On the average, the mineral soil had roughly eight times as many seedlings per acre as occurred on the duff under otherwise similar conditions. Burned surfaces are not presented in the comparison, because they did not occur on all locations studied. However, burning appears to be nearly as effective as exposing the mineral soil by mechanical means.

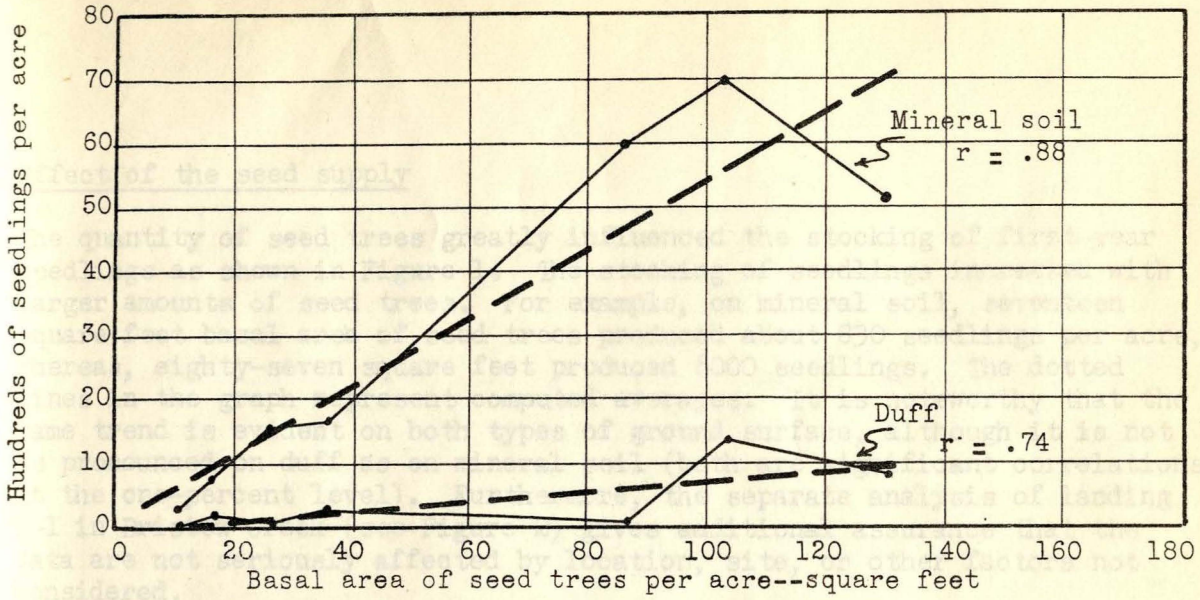

Figure 1.--Number of first-year seedlings on two seedbed conditions as related to the stocking of seed trees.

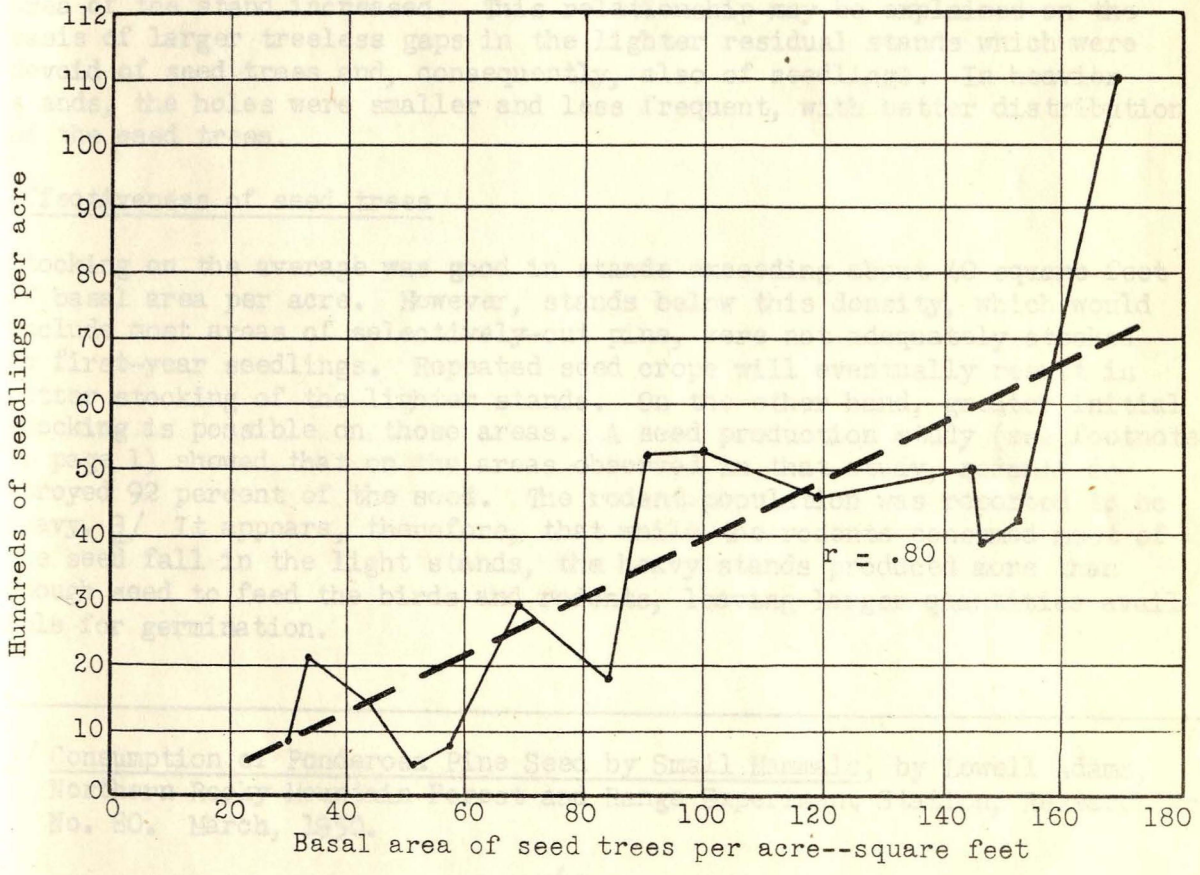

Figure 2.--Number of first-year seedlings on mineral soil as related to the stocking of seed trees on landing C-1, Bristow Creek.

Effect of the seed supply

The quantity of seed trees greatly influenced the stocking of first-year seedlings as shown in Figure 1. The stocking of seedlings increased with larger amounts of seed trees. For example, on mineral soil, seventeen square feet basal area of seed trees produced about 830 seedlings per acre, whereas, eighty-seven square feet produced 6000 seedlings. The dotted lines in the graph represent computed averages. It is noteworthy that the same trend is evident on both types of ground surface, although it is not as pronounced on duff as on mineral soil (both are significant correlations at the one-percent level). Furthermore, the separate analysis of landing C-1 in Bristow Creek (see Figure 2) gives additional assurance that the data are not seriously affected by location, site, or other factors not considered.

Effect of distribution of seed trees upon distribution of seedlings

Seedlings were better distributed under the heavier stands than under the lighter stands of seed trees. The trend depicted in Figure 3 shows larger percentages of plots stocked, hence, better distribution, as the basal area of the stand increased. This relationship may be explained on the basis of larger treeless gaps in the lighter residual stands which were devoid of seed trees and, consequently, also of seedlings. In heavier stands, the holes were smaller and less frequent, with better distribution of the seed trees.

Effectiveness of seed trees

Stocking on the average was good in stands exceeding about 40 square feet of basal area per acre. However, stands below this density, which would include most areas of selectively-cut pine, were not adequately stocked by first-year seedlings. Repeated seed crops will eventually result in better stocking of the lighter stands. On the other hand, greater initial stocking is possible on those areas. A seed production study (see footnote 2, page 1) showed that on the areas observed in that study, rodents destroyed 92 percent of the seed. The rodent population was reported to be heavy. 3/ It appears, therefore, that while the rodents consumed most of the seed fall in the light stands, the heavy stands produced more than enough seed to feed the birds and rodents, leaving larger quantities available for germination.

3/ Consumption of Ponderosa Pine Seed by Small Mammals, by Lowell Adams, Northern Rocky Mountain Forest and Range Experiment Station, Research Note No. 80. March, 1950.

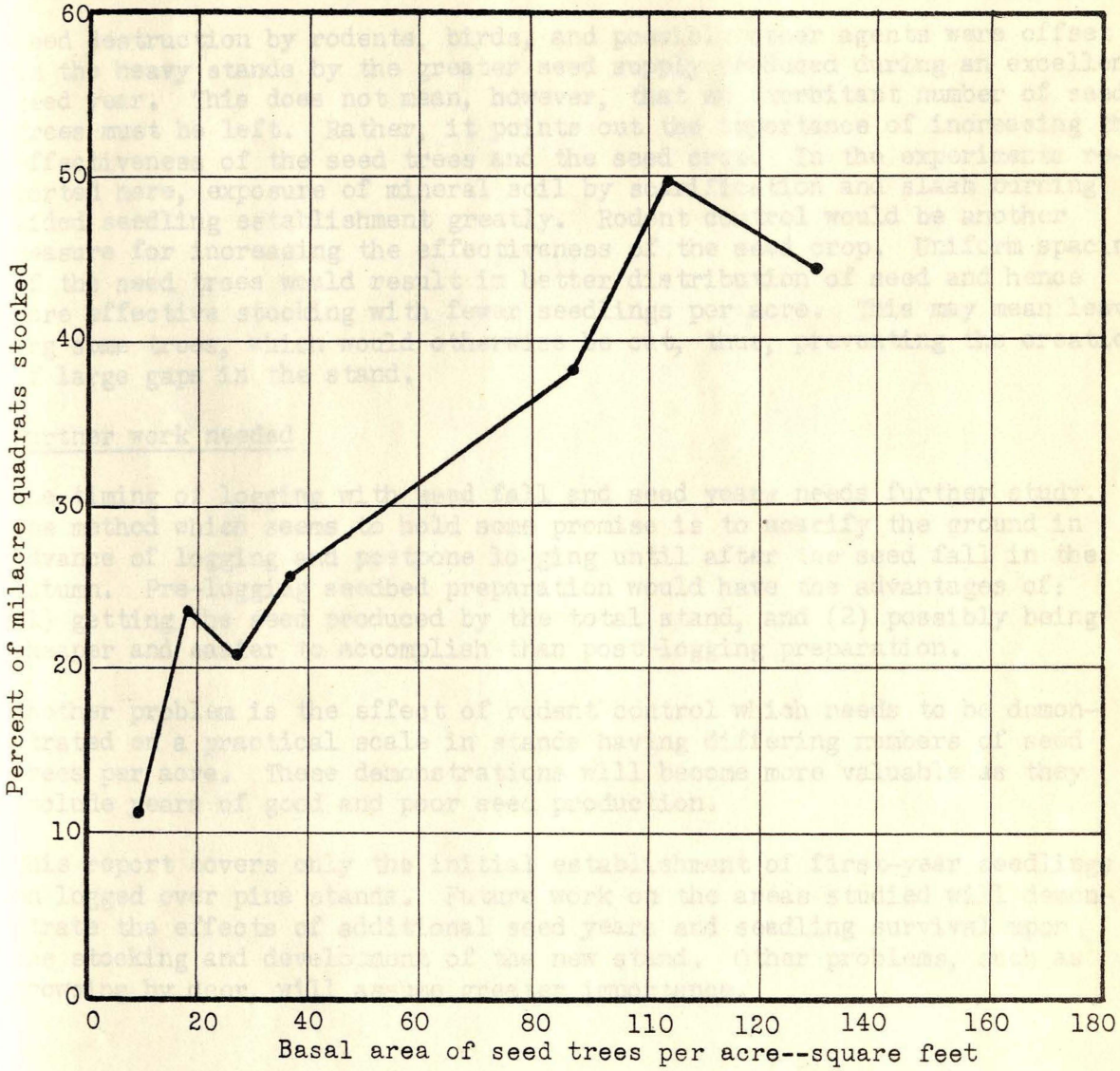

Figure 3.--Distribution of first-year seedlings as related to the stocking of seed trees.

Application of results to forest management

Seed destruction by rodents, birds, and possibly other agents were offset in the heavy stands by the greater seed supply produced during an excellent seed year. This does not mean, however, that an exorbitant number of seed trees must be left. Rather, it points out the importance of increasing the effectiveness of the seed trees and the seed crop. In the experiments reported here, exposure of mineral soil by scarification and slash burning aided seedling establishment greatly. Rodent control would be another measure for increasing the effectiveness of the seed crop. Uniform spacing of the seed trees would result in better distribution of seed and hence more effective stocking with fewer seedlings per acre. This may mean leaving some trees, which would otherwise be cut, thus, preventing the creation of large gaps in the stand.

Further work needed

The timing of logging with seed fall and seed years needs further study. One method which seems to hold some promise is to scarify the ground in advance of logging and postpone logging until after the seed fall in the autumn. Pre-logging seedbed preparation would have the advantages of: (1) getting the seed produced by the total stand, and (2) possibly being cheaper and easier to accomplish than post-logging preparation.

Another problem is the effect of rodent control which needs to be demonstrated on a practical scale in stands having differing numbers of seed trees per acre. These demonstrations will become more valuable as they include years of good and poor seed production.

This report covers only the initial establishment of first-year seedlings on logged over pine stands. Future work on the areas studied will demonstrate the effects of additional seed years and seedling survival upon the stocking and development of the new stand. Other problems, such as browsing by deer, will assume greater importance.

APPENDIX

Table 1.--Board foot volume and average trees per acre equivalents for basal area

Basal area per acre	Volume of trees 10 inches d.b.h. and larger	Trees 10 inches d.b.h. and larger
Sq. ft.	Bd. ft.	Number
10	1/ 2,000	1/ 5
20	4,300	9
30	6,500	12
40	8,800	16
50	11,100	19
60	13,400	23
70	15,700	26
80	17,900	30
90	20,200	34
100	22,500	37
110	24,800	40
120	27,100	44
130	29,300	48

1/ These are approximations derived from freehand curves.

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